1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States, pursuant to section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states to identify and prioritize water bodies that are water quality limited (i.e. water bodies that do not meet water quality standards). States must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Mid Snake River/Succor Creek Subbasin that have been placed on what is known as the "§303(d) list."

The overall purpose of this subbasin assessment and TMDL is to characterize and document pollutant loads within the Mid Snake River/Succor Creek Subbasin. The first portion of this document, the subbasin assessment, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). This information will then be used to develop a TMDL for each pollutant exceeding the water quality standards in the Mid Snake River/Succor Creek Subbasin (Chapter 5).

1.1 Introduction

In 1972, Congress passed public law 92-500, the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act was to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). The act and the programs it has generated have changed over the years as experience and perceptions of water quality have changed. The CWA has been amended 15 times, most significantly in 1977, 1981, and 1987. One of the goals of the 1977 amendment was protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency should help define appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the "§303(d) list." This list describes water bodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable pollutant loading for water bodies on the 303(d) list. The *Mid Snake River/Succor Creek Subbasin Assessment and Total Maximum Daily Load* provides this summary for the currently listed waters in the Mid Snake River/Succor Creek Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Mid Snake River/Succor Creek Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR § 130). Consequently, a TMDL is water body and pollutant-specific.

The TMDL also includes individual pollutant allocations among various point and nonpoint sources discharging the pollutant as well as a margin of safety (MOS) to account for uncertainty in pollutant measurement and dynamics. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of specific pollutants as "pollution." TMDLs are not required for water bodies impaired by pollution, but by specific pollutants. In other words, if flow alteration was determined to be the only factor impairing a stream, then a TMDL would not be required since flow alteration is not a pollutant.

In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through anti-degradation provisions.

The state may assign or designate beneficial uses for particular Idaho water bodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)

- Water supply – domestic, agricultural, industrial, mining, commercial
- Wildlife habitats, aesthetics

The Idaho legislature designates uses for water bodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water and primary contact recreation are presumed to be the designated uses when the water body is assessed.

A subbasin assessment entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining water quality standards).

- Determine the degree of achievement of biological integrity.

- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.

- When water bodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Mid Snake River/Succor Creek Subbasin is a 2,002 square mile semi-arid watershed that lies in the Snake River Basin. To the north of the Snake River, the terrain is primarily a gently rolling basaltic plain occasionally studded by gently sloped buttes. To the south lies a dissected lowland plateau of valleys, canyons, and mesas that increases in elevation as they rise to meet the Owyhee Mountains. The tributaries to the Snake River are primarily low volume rangeland streams that run through sagebrush steppe country. While the Mid Snake River/Succor Creek watershed extends into Oregon, this subbasin assessment concentrates on those water bodies located in Idaho. Figure 1.0 shows the subwatersheds that comprise the Mid Snake River/Succor Creek watershed in Idaho.

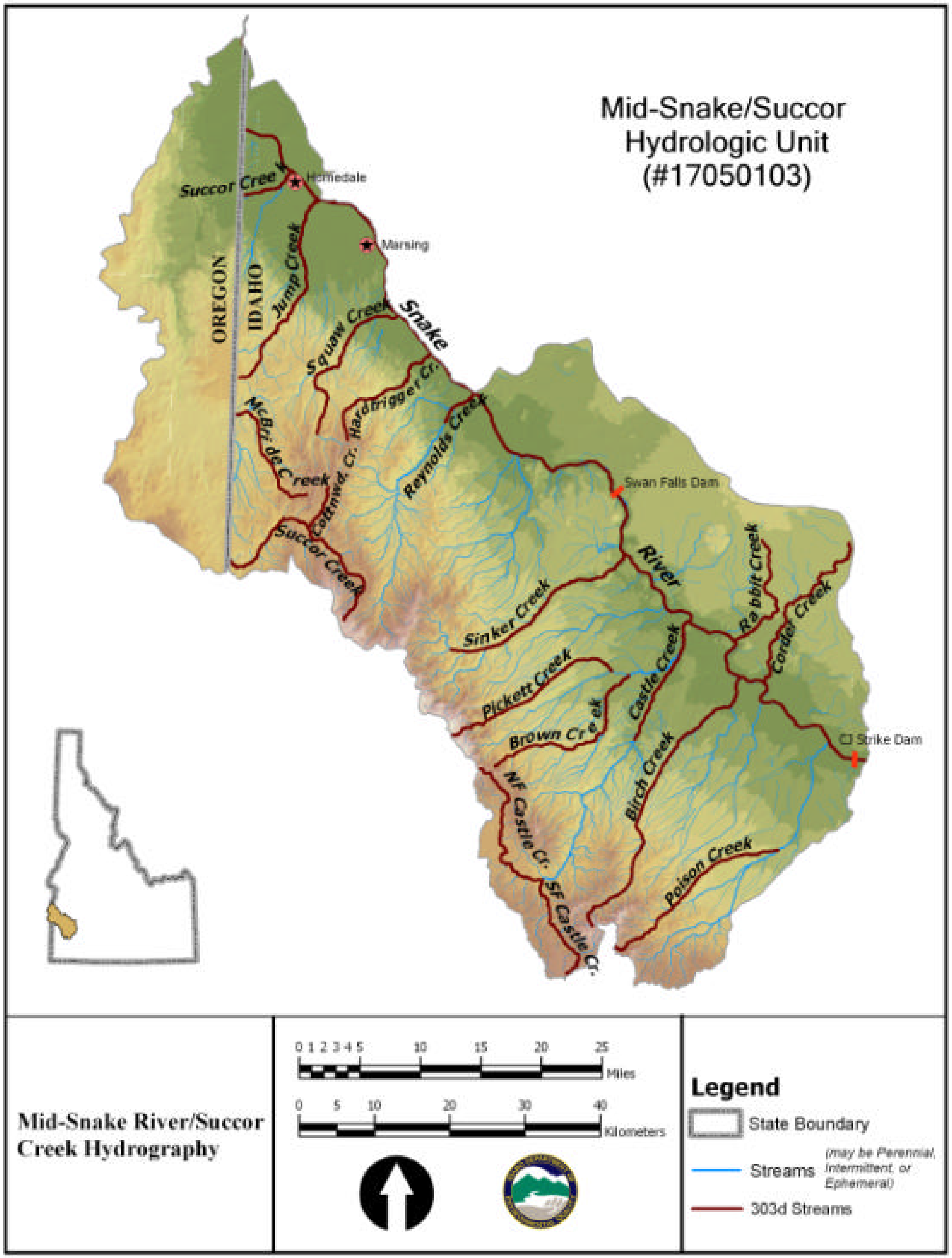

Figure 1.0 Mid-Snake/Succor Hydrography

Climate

The climate in an area is defined by several environmental variables, including its proximity to the ocean, the movement of air masses across pressure ridges and the angle of the sun at certain times of the year. Areas that share geographic similaries share similar climates. However, it should be noted that within climatic regions, weather patterns can differ drastically. As and example, the Boise Front and the Owyhee Mountains have similiar climatic characteristics, but often have different weather patterns.

The Mid Snake River/Succor Creek watershed is characterized by a semi-arid climate: hot and dry in the summer and cold and dry in the winter. Grand View is located along the Snake River, approximately 8 miles downstream of CJ Strike Dam. July is generally the hottest month with the greatest evaporation, while January is the coldest and has the least evaporation. Precipitation is bi-modal with intense, short duration summer storms and milder, longer duration winter storms. More than half of the precipitation falls November through January.

The Owyhee Mountains receive an average of 30 inches of snow per year in the higher elevations, while the lower elevations along the Snake River receive an average snowfall of under 6 inches. Figures 1.1 and 1.2 show the temperature and precipitation regimes in the lower elevations of the watershed. The differences in precipitation due to topography are shown in Figure 1.3 (Western Regional Climate Center 2002).

The closest climate station that yields percent possible sunshine per month is located in Boise, Idaho which is in an adjoining watershed. The climate in Boise is also semi-arid and thus, relatively similar. Table 1 shows the percent possible sunshine per month for the Boise area. Corresponding to the months of the hottest temperatures, the months with the highest percent sunshine are July and August.

Table 1. Percent possible sunshine per month.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Avg
Boise	40	51	62	68	70	75	87	85	82	69	43	38	64%

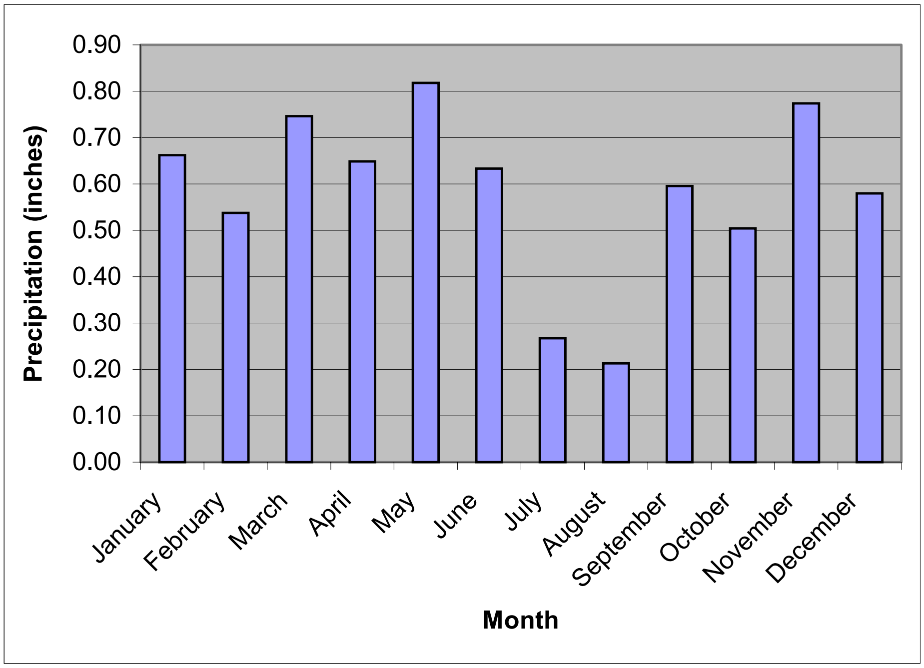

Figure 1.1 Average Monthly Precipitation for Grand View, Idaho

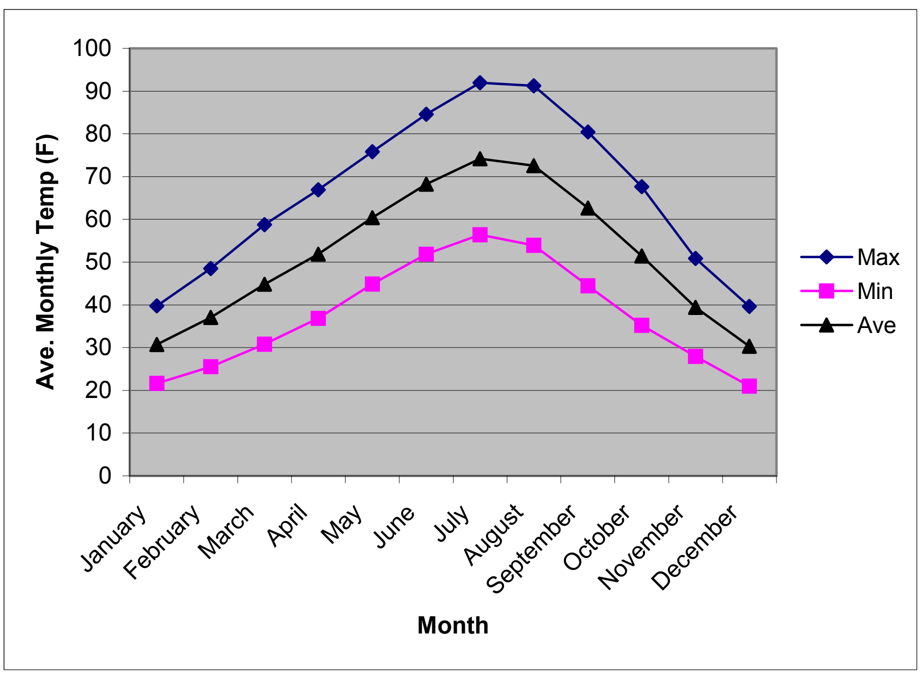

Figure 1.2 Average Monthly Temperatures for Grand View, Idaho

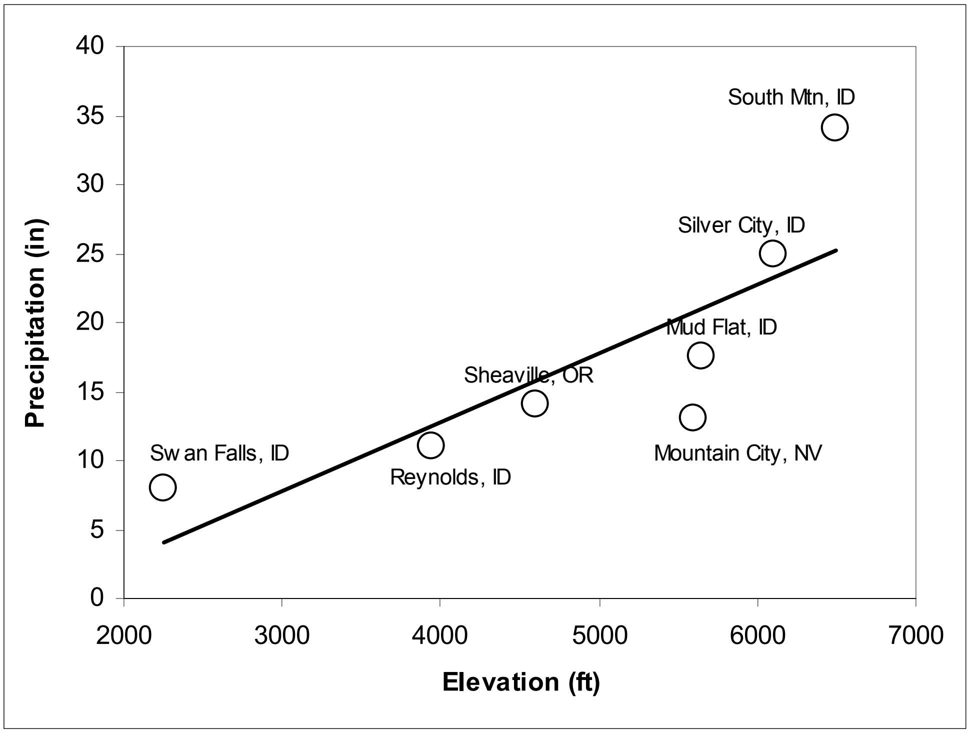

Figure 1.3 Increase in Precipitation with Increase in Elevation for Owyhee Mountains (Mountain City, NV; Sheaville, OR; and South Mountain, Owyhee Range, but not in Mid Snake River/Succor Creek Watershed)

Subbasin Characteristics

This section describes provides a cursory description of the Mid Snake River/Succor Creek watershed from a vegetative, geologic, climatic and hydrologic standpoint. More detail on each subbasin is also provided.

Vegetation

The Mid Snake River/Succor Creek watershed lies entirely in the Snake River Plain eco-region and is characterized primarily by sagebrush steppe vegetation (Omernik and Gallant 1986). Sagebrush directly influences the soil microclimate by accumulating vegetative litter to a much greater depth than adjacent grasses and by insulating the soils via its plant canopy. The combination of insulation from litter and canopy shade has a significant effect on the soil-water potential (the amount of water the soil can absorb). In the Snake River canyon as well as in the foothills to the south of the Snake River, saltbush greasewood vegetation is predominant. Cheatgrass, a non-native, invasive species, occurs in areas that have been disturbed. In the higher elevations, junipers are often present. The decreased frequency of fire (a significant mortality factor for junipers) in the higher elevations due to historic grazing practices has resulted in juniper encroachment into lower elevations. This encroachment is believed to have started occurring in the 1860’s.

The Mid Snake River/Succor Creek watershed shows a vertical succession of plant associations from the lowest to highest elevations. The elevations at which various plant associations occur depend on characteristics such as latitude, exposure, soil, and moisture, while the width of the belts depends on the steepness of the slope (UDNR-DWR 1975).

Streamside vegetation often provides more important wildlife habitat due to the richer growth of plants than does the surrounding upland areas. At the lower elevations within the watershed, vegetation includes cottonwood trees and numerous shrubs such as sagebrush, greasewood, willows, wild rose, and dogwood. Wetlands and marshes found in the watershed offer good conditions for waterfowl. There are 159 islands in the Snake River (recently transferred from the U.S. Fish and Wildlife Service's (USFWS) Deer Flat National Refuge to the state of Idaho) and these are of great importance to waterfowl. Higher in the mountain canyons, the streams are lined with willow, dogwood, and other riparian shrubs. Cropland and irrigated pastures provide habitat for a number of animals such as pheasants, quail, and rabbits. They also provide feed for resident and migrating waterfowl.

Wildlife

This discussion focuses on the wildlife in the Mid-Snake River/Succor Creek watershed that could have a measurable effect on stream health. The watershed, in addition to being susceptible to the effects of livestock grazing, is also potentially susceptible to the effects of large mammals such as elk, deer and wild horses. The BLM has wild horse management areas throughout the watershed. The BLM's objective is to keep wild and free-roaming horses at appropriate management levels within a thriving natural ecological balance. To reach this objective, the BLM has established forage allocation (AUMs) by herd management area. Where there has been development of water sources for livestock in wildhorse management areas, there is the potential for riparian damage as the horses no longer roam as far to get to water and may yard up. In general, however, wild horses exhibit seasonal grazing patterns, following the green up to higher elevations and thus, do not stress one particular area for an extended period of time.

Deer and elk may have an impact on riparian areas at certain times of the year, particularly if large numbers of animals are in an area for an extended period of time. Like wild horses, deer and elk generally follow the green up exhibiting seasonal as opposed to season long grazing activity.

While in general beavers are beneficial to riparian areas, certain instances have occurred where populations rapidly expanded and riparian degradation took place.

Fisheries

Snake River
The stretch of the Snake River between CJ Strike Dam and the Oregon line is characterized by a dominance of game fish. In 1995, the Idaho Department of Fish and Game (IDFG) conducted an electrofishing study on the Snake River. From Swan Falls Dam to Walter's Ferry, 73% of the fish captured were game fish and smallmouth bass was the dominant

species. From below CJ Strike Dam to Swan Falls Reservoir, carp were the dominant species. Other species that occur in this area of the Snake River include rainbow trout, largemouth bass, channel and flathead catfish, black crappie, yellow perch, and sunfish as well as other non-game species (Anglin 1992). White sturgeon are considered a sensitive species by the state of Idaho and are also found in this reach, mainly below Swan Falls Dam. More information on fisheries in the Snake River is located in Section 2.3.

Tributaries
In the tributaries, the only salmonid generally present is redband trout. Redband trout are a strain of rainbow trout and are typically associated with desert watersheds. Based upon the distribution of redband trout they appear to have developed a tolerance for the higher water temperatures (higher then the salmonid spawning criteria) found in the Owyhee desert. That is, redband trout that inhabit many of the Owyhee Mountain streams appear to have successfully propagated despite exceedances in the salmonid spawning temperature criteria. However, even though redband trout can live in naturally higher water temperatures, there is little flexibility regarding further degradation of substrate and temperature conditions in the streams.

The loss of desert riparian habitat that cools stream temperatures and filters surface runoff is a factor in determining the population dynamics of the redband trout. Loss of riparian habitat occurs due to both human caused (i.e. grazing, recreation) and natural factors (i.e. extreme flood or fire). The degree of riparian loss is directly related to the severity of the human or natural activities. Higher densities of redbands are found in the upper reaches of the tributaries where temperatures are cooler and riffles and pools are more prevalent. Fisheries data for the tributaries are found in Table 2.

The IDFG has determined that the lower sections of the listed tributaries, the response reaches, generally do not provide salmonid spawning habitat and have probably historically served primarily as migratory corridors (see Appendix F). Seasonal migration to the Snake River may be limited due to barriers caused by irrigation diversions. The potential to improve salmonid spawning habitat in these reaches is low due to the low gradient, habitat alteration, flow diversion and associated high temperatures. Salmonid spawning does occur in the upper reaches of many subwatersheds where better habitat conditions and higher gradients exist.

Table 2. Listed segments for which fish information exists

Water Body	Year Assessed	Fish Present[1]
Brown Creek	NA	No data
Birch Creek	NA	No data
Castle Creek	1994	Redband trout, dace sp., bridgelip sucker
Jump Creek	1994	Redband trout

McBride Creek	1996	No fish observed, no historical redband habitat (BLM 1997)
Pickett Creek (T5SR1WS32 to Catherine Creek)	NA	No data
Pickett Creek (headwaters to T5SR1WS32)	1996	Redband trout
Poison Creek	NA	No data
Reynolds Creek	NA	Redband trout, dace sp., bridgelip sucker, redside shiner
Sinker Creek	1995	Redband trout
South Fork Castle Creek	1993	Redband trout
Squaw Creek	1997	Bridgelip sucker, dace sp.
Succor Creek (Headwaters to .92 miles above Succor Creek Reservoir	2002	Redband trout, dace sp., bridgelip sucker, redside shiner

[1] All data collected using a backpack electrofisher

Geology

The Mid Snake River/Succor Creek watershed is part of the Snake River Plain, which is characterized by numerous buttes and basalt canyons formed by ancient lava flows. The western plain of the Snake River extends from near King Hill to Weiser. The plain is a fault-bounded shallow depression underlain by a mix of Quaternary and Tertiary sedimentary and volcanic rock. The western Snake River Plain is underlain by a section of sedimentary material that may be in excess of 5,000 feet thick in the central portion of the basin. The generally fine-grained nature of the sedimentary material does not allow ground water to move as freely as it does in the eastern Snake River Plain (Newton 1978). Faults typically trend in a westerly or northwesterly direction. Relatively few faults can be detected from the surface.

Both black basalt and light colored rhyolite are found throughout the watershed. Most of the volcanic rock in the watershed dates to the Pliocene era and was likely associated with the North American tectonic plate moving over a hot spot beneath the Columbia Plateau Province, resulting in basalt flows and explosions of rhyolite.

Fourteen thousand years ago, the Bonneville Flood had a significant effect on the topography of the Snake River canyon today. The Snake River canyon already existed, but the magnitude and velocity of the flood waters, estimated at 33 million cubic feet per second (cfs), resulted in substantial downcutting as well as the creation of box canyons along cliffs where eddies formed. Not only were the canyons a result of the flood, but places such as Wees Bar were formed due to enormous eddies that deposited sediment and huge boulders. The “melon” boulders, polished smooth by the tumbling action of the high velocity flood, that are found at Wees Bar and Celebration Park were later used by Native Americans for petroglyphs. Figure 1.4.1 shows the geologic formations that make up the watershed. Figure 1.4.2, the legend for figure 1.4.1, is found on the following page.

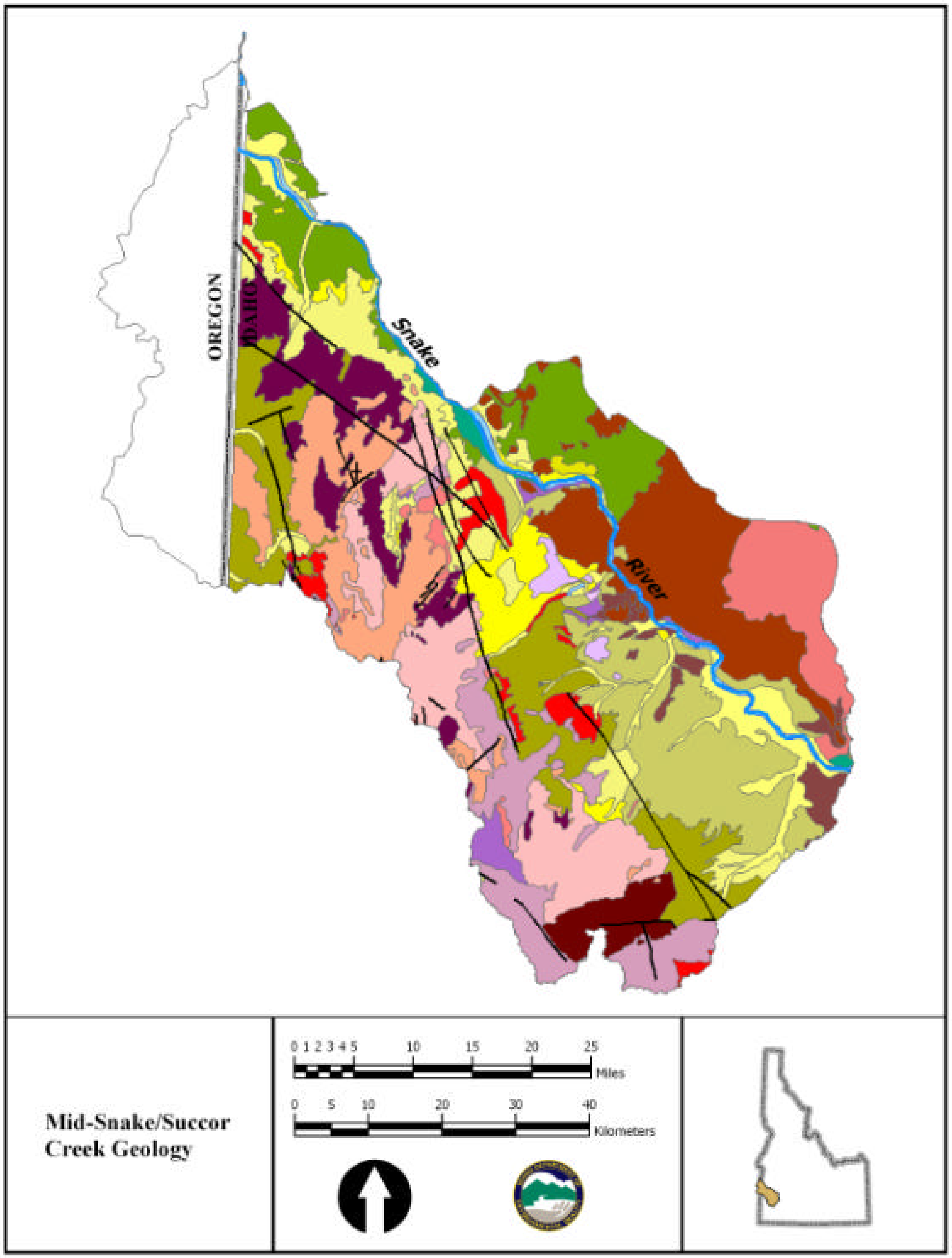

Figure 1.4.1 Mid Snake/Succor Geology

Figure 1.4.2 Mid-Snake/Succor Geology Legend

Soils

The Snake River Basin is characterized by aridisols and aridic mollisol soils. Aridisols are mineral soils, typically found in arid regions, light colored, and low in organic matter. They often have surface accumulations of soluble salts and lime. The lower the precipitation, the more frequently these accumulations are found on the surface. In the Mid Snake River/Succor Creek watershed there are both orthids (aridisols that have accumulations of calcium carbonate or other salts but no clay accumulations in the horizons) and argids (aridisols with a clay horizon).

The ardisols and mollisol soils are composed of loess (calcareous silt transported by wind deposits), residuum (soil produced from weathering of rock directly beneath it), colluvium (loose deposits at the foot of a slope brought there by gravity), and alluvium (deposits of silt or silty clay deposited as a result of flooding).

Mollisols are well-drained soils with organic-rich surface horizons and that are rich in basic cations such as calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), and sodium (Na^{+}). Xerolls are the most common suborder of the Mollisol soils within this reach. These soils develop in moist winter/dry summer climates, and are continually dry for long periods of time. These soils dominate the steppe and shrub-steppe vegetation areas in the reach and when kept moist (i.e., through irrigation) are important for grain and forage (Oregon State University, 1993).

Figure 1.5 shows the erodibility, or K factors for the soils in the watershed. The soils are predominantly moderately erodible soils. The K factor is an erosion susceptibility factor that shows how easily soil will detach and transport when subjected to rainfall and runoff.

Figure 1.6 shows the erosion potential in the watershed. This potential was developed using an analysis of the K factor, wind erodibility group, and slope. Areas of high erosion potential are typically steep sloped, high K factor sites. Slope plays a more significant factor in this determination than the K factor or wind erodibility group.

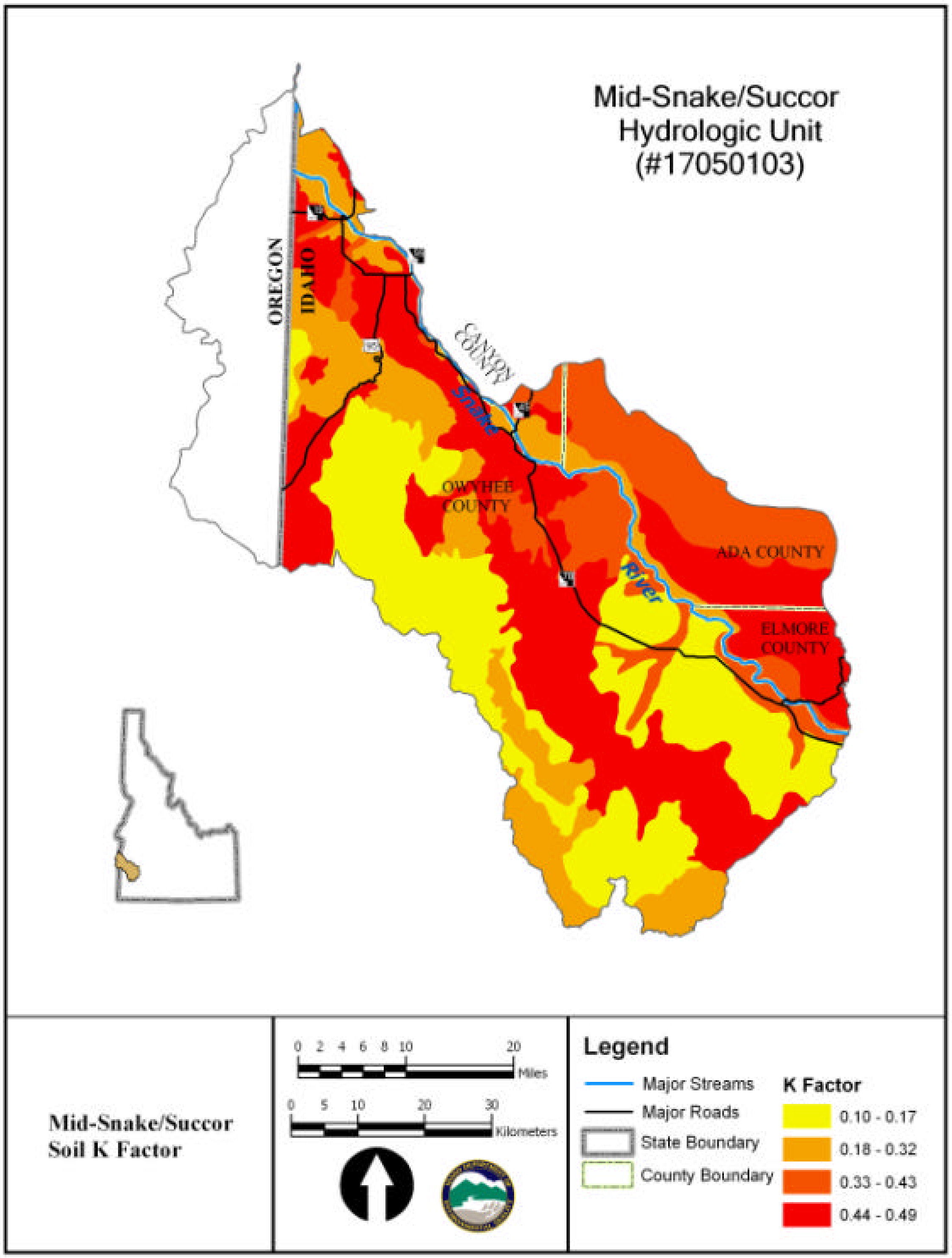

Figure 1.5 Mid-Snake/Succor Soil K Factor

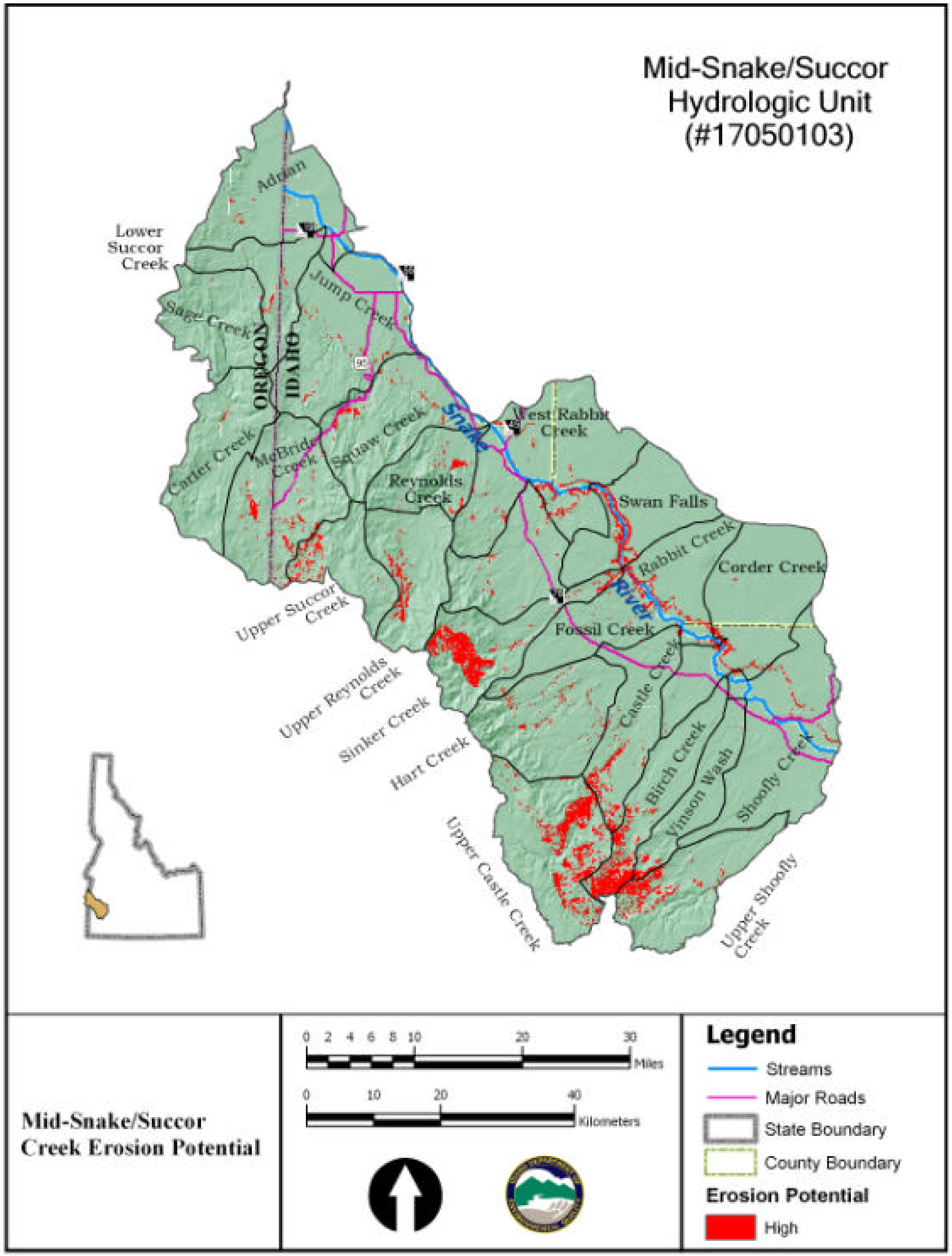

Figure 1.6 Mid-Snake/Succor Erosion Potential

Topography

Characterized by basalt canyons and buttes, the predominant aspect of the Mid-Snake River/Succor Creek watershed is southeasterly. Elevations are highest in the southern part of the watershed. In this area, streams flow out of the front range of the Owyhee mountains, coursing through canyons and sagebrush covered hills, before flattening out in the valleys that surround the mainstem Snake River, as shown in Figure 1.7.

The mean elevation in the watershed is 2,487 feet. The highest elevations are over 8,000 feet and are found in the Silver City Range bounding the southern edge of the watershed. The lowest elevation of 2,168 feet is found at the most downstream point of the Snake River on the eastern edge of the watershed.

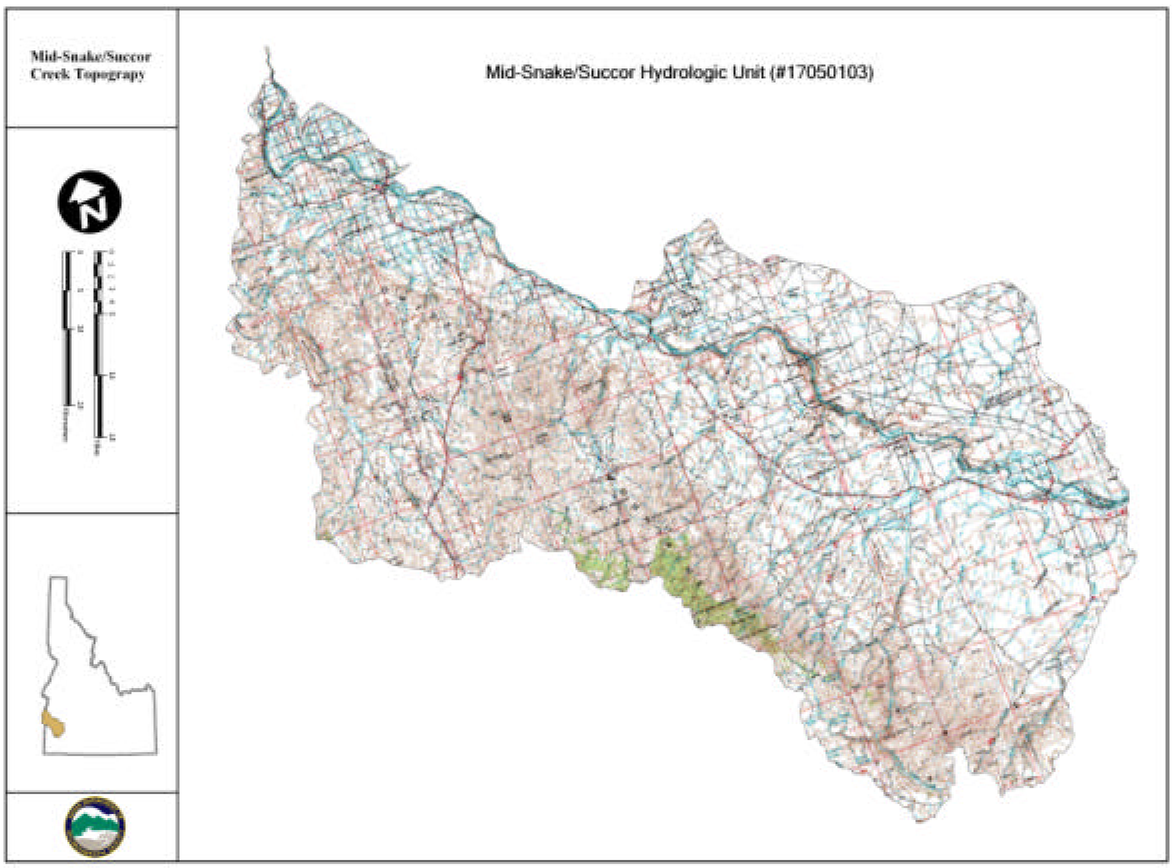

Figure 1.7 Mid-Snake/Succor Topography

Ground Water

The western plain of the Snake River extends from near King Hill to near Weiser. The plain is a fault-bounded depression underlain by a mix of Quaternary and Tertiary sedimentary and volcanic rock. While relatively few faults can be detected from the surface, they have an impact on the dynamics of vertical and horizontal ground water movement. Ground water in the watershed is typically deep (>100 feet) except in the areas near Grand View and Homedale, where levels may be in the tens of feet. Ground water in these areas and near Murphy has been found to have elevated levels of nitrates. The high levels in the Grand View area have been attributed to fertilizer use. Shallow ground water (subsurface recharge) has also been found to contain high concentrations of phosphorus (DEQ 1991). Agricultural chemicals can reach ground water in significant quantities under conditions of high soil permeability, chemical mobility, and water application practices. With appropriate placement, management, and control programs in place, effects from these nonpoint sources can be minimized or removed in many cases (USBR 1998).

The Grand View area is a ground water management area where state permission is required to drill additional wells. This classification is in place due to water level declines attributable to extensive ground water development.

Ground water in the region is present in two stratums. Water can be found under artesian conditions (confined) or under water table conditions (unconfined). Water in the shallow, unconfined alluvium is generally cold, while the deeply confined water is a mix of cold and hot water. Artesian wells occur south of the Snake River at elevations of 2,700 feet or less and usually produce free flowing geothermal water. This mix of cold/hot conditions is typically found along fault zones or through conveyances that penetrate more than one geologic profile. Some thermal water may leak upward into overlying cold-water aquifers and discharge to the Snake River as part of those sources (Lindholm 1988).

The Banbury Basalt aquifer is the most productive aquifer in the westerly plain. Other aquifers include the Poison Creek Formation, Glens Ferry Formation, and Tertiary Silicic volcanics. In general, aquifers are made up of sand, gravel, and to a lesser extent, basalt. The aquifers in northern Owyhee County, adjacent to the Snake River are typically unconsolidated and fine-grained. Hydrogen sulfide and methane emissions occur in some wells due to organic debris in the fine-grained deposits. Thus, some communities actually obtain their water from wells north of the river in Canyon County where unconsolidated-deposit aquifers are more permeable (Norvitch et al. 1969).

The movement of ground water through the profile trends with the hydrologic gradient. Water on the north side of the Snake River moves in a southwesterly direction to the river and water on the south side moves in a northwesterly direction to the river. The rate of water movement is dependent on hydraulic head, which varies throughout the watershed.

Water storage, particularly on the south side of the river, has generally decreased since 1972 (Kjelstrom 1995), although in the past there have been periods of increased recharge and storage. Recharge and storage rates are linked to climatic events, domestic water supply demand, and agricultural/irrigation water supply demand. In the uplands, recharge rates are closely linked to infiltration from precipitation. In the lowlands, recharge rates are linked to inter-aquifer flow, infiltration from perennial and intermittent streams and ditches, and precipitation, among other things.

Within the Snake River Basin, surface and ground water systems are interconnected. Changes in ground water recharge or discharge have been observed to affect surface water flows (Goodell 1988). Similarly, infiltrating water from irrigation systems and stream flows represent a significant portion of the ground water budget (USBR 2001). At many places in the basin, the Snake River channel is above the regional water table and instead of the aquifer discharging to the river, the river recharges the underlying aquifer (USBR 1998). In low-water years, pumping and diversions can remove more water from the Snake River than is contributed by some of the inflowing tributaries. Irrigation recharge during periods of low tributary input represents a significant source of in-river flow (as much as 52%) (IDWR and ODWR water supply data). Throughout the entire Snake River Plain millions of acre-feet of surface water are diverted annually for irrigation purposes. This increased application of water for surface irrigation has also artificially raised the water table by tens of feet throughout the plain (Lindholm 1996).

The aquifers found in the Snake River drainage areas provide ground water for use within the individual drainage areas. These also provide varying amounts of recharge, in the form of subsurface ground water inflow. While shallow ground water (subsurface recharge) in the watershed is more easily influenced by agricultural and storm water pollutants, deep ground water in the watershed is commonly of higher quality, suitable for drinking, agriculture, and industrial uses. Deep ground water quality is often better than that required to meet national drinking water standards.

River Characteristics

The Snake River originates at 9,500 feet along the continental divide in Wyoming and flows 1,038 miles to the confluence with the Columbia River in Pasco, Washington. The Mid Snake River/Succor Creek reach begins at river mile 494. The Snake River is a large volume river that is one of the most important water resources in the state. The Mid Snake River/Succor Creek reach is an important agricultural, recreational, and wildlife resource as well as a hydroelectric power source. Flowing in a northwesterly direction, the Mid Snake River/Succor Creek reach is 90.73 miles long, from below CJ Strike Dam to the Oregon line. In this reach, the river flows through basalt canyons, rangeland, and agricultural land. The channel shape varies from confined in the canyons to wide single channel areas with extensive floodplains and meandering channels with island complexes. Swan Falls Dam and Reservoir (a run of the river reservoir) are also located within the watershed. In the Mid Snake River/Succor Creek watershed, the tributaries to the Snake River generally only contribute substantial flow for a few days in winter or early spring due to run-off events.

The §303(d) listed segment originates below the CJ Strike Dam. CJ Strike Reservoir, which is not a part of this TMDL, impounds approximately 24 miles of the Snake River and almost 10 miles of the Bruneau River. The reservoir has a storage capacity of 240,000 acre-feet and a surface area of approximately 7,500 acres. The resulting effect downstream of fluctuating dam releases is elevational changes of up to 3 feet during a typical day. Ninety percent of the tailwater elevational changes are less than 1 foot.

Forty-nine of the 72 miles of the Snake River between CJ Strike and Swan Falls Dams supports wetland or riparian vegetation. A 1997 aerial photograph interpretation by DEQ indicates that riverbank and island vegetation was 20% forest, 40% shrub riparian habitat, 30% shore/bottomland wetland, and 10% emergent herbaceous vegetation. However, it is important to note that in this aerial photograph interpretation, russian olives and tamarisk are potentially included in this forest designation. Both of these are invasive, undesirable species considered noxious weeds by the state of Idaho. An instream flow incremental methodology study determined that the area of channel impact averages 4.1 feet on either side due to variable releases (i.e., 4.1 feet of shore might be vegetated if variable releases did not occur) (IPC 1998).

The reach from below CJ Strike Dam to Swan Falls Reservoir (river mile 468.6) initially runs through an extensive agricultural area before it enters a steep canyon in the lower section of that reach.

The river enters Swan Falls Reservoir at mile 480. Surrounded by steep cliffs, this run of the river, 6,800 acre-foot impoundment, stretches approximately 10 miles upstream to Big Foot Bar. Previous studies have shown that the average cross section in the reservoir is not much greater than that of a river section, and the volume of water in the reservoir is not much greater than an average river section of comparable length. Because of the hydrology of the reservoir, the retention time in the reservoir is short and the waters tend to remain well mixed. During summer, the retention time was estimated at 0.6 days, meaning that nutrients and phytoplankton would pass through the system before horizontal gradients could be established.

Sampling in 1993 by DEQ showed that temperatures were nearly isothermal during the summer and dissolved oxygen (DO) levels were also correspondingly orthograde with depth (DEQ 1993). Additional DO/temperature profiles taken by Idaho Power (IPC 2002) have shown similar results. Variations in inflow slightly altered the vertical stability of oxygen in the upstream section of the reservoir. A longitudinal gradient of oxygen was present, increasing in the downstream section of the reservoir with a corresponding increase in chlorophyll-a.

Both lentic and lotic habitat, due to the presence of Swan Falls Dam and the resultant Swan Falls Reservoir, characterize the Snake River. Behind Swan Falls Dam for about 10 river miles upstream to Big Foot Bar is a lentic habitat in the Swan Falls Reservoir. Warm water fish such as carp and sucker are found in this area as well as in the lotic habitat. Sturgeon, whitefish, and trout are found in the lotic habitat.

Below Swan Falls Dam, the river displays swift current, pools, rapids, and riffles. The Snake River downstream of CJ Strike Dam to Swan Falls Reservoir flows through extensive agricultural development before entering Swan Falls Reservoir. Shallow fast runs and simple island complexes characterize the river. There are few deep runs or pools in this stretch. Steep canyon walls are predominant in the Swan Falls Reservoir area, creating a run of the river reservoir.

From below Swan Falls Dam to Walters Ferry, the river channel is a high gradient reach (3.54 feet/mile) that passes through basalt cliffs and scattered boulder fields. The river in this section has a more diverse hydrology and habitat then the upstream sections. This reach has deep fast runs, multiple and single island complexes, rapid/riffle areas, and a few deep pools.

The Walters Ferry reach has the lowest gradient (1.27 feet /mile). There are multiple and single island complexes, mainly shallow runs, and a few deep runs or pools. Agricultural development is prevalent throughout this reach. There are several major pumping stations, many small individual pump stations, and numerous agricultural return drains throughout this reach.

Erosion and instream biological productivity provide most of the sediment in the Mid Snake River/Succor Creek reach of the Snake River. Sediment originates from natural (e.g., gully erosion, high flow events) and anthropogenic sources (road erosion, agricultural lands, urban/suburban storm water runoff, and construction sites). Sediment concentrations within the system are highest in spring in association with high flow volumes and velocities from snowmelt runoff. Since this reach is bounded on the upstream end by CJ Strike Dam, sediment inputs are limited to some degree by the controlled nature of the watershed. This control can reduce the amount of sediment delivered to this reach. Sediment transport and the transport and delivery of sediment bound pollutants are directly associated with increased flow volumes and high velocities.

Nutrient sources are both natural and anthropogenic, including nutrient loading from agricultural activities, grazing, and wastewater treatment plants. More information on nutrient sources can be found in Chapter 3.

Land Use

As shown in Figure 1.8, over 80% of the land in the watershed is rangeland. Land use is dominated by grazing and, to a lesser extent irrigated agriculture for all the watersheds. Fourteen percent of the land in the Mid Snake River/Succor Creek watershed is under cultivation (DEQ 2002a).

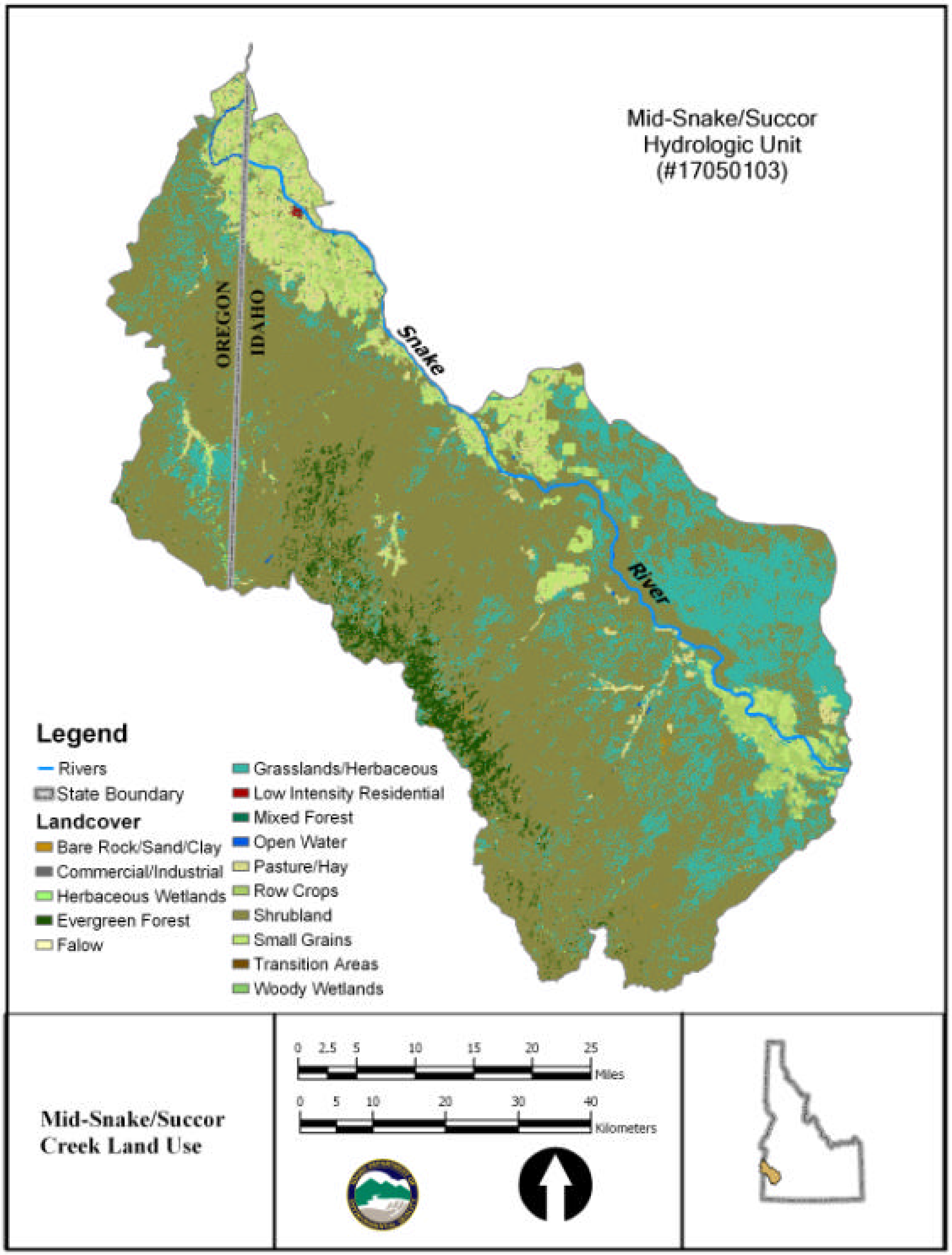

Figure 1.8 Mid Snake/Succor Land Use

Subwatershed Characteristics

Of all the streams and rivers in the watershed, almost 81% of the total stream lengths are classified as intermittent (Montana State University, 2002). Most of the tributaries exhibit similar characteristics: they start along the front range as higher gradient, lower sinuosity V-shaped channels (Rosgen B channels) before exiting to the plains area and becoming more sinuous, lower gradient, chisel-shaped channels. Rosgen B-type channels are sediment transport channels and are most common throughout the upper elevations of the subbasin. These channels have moderate gradients, sinuosity, width to depth ratios, and entrenchment ratios. They occur in narrow, moderately sloping valleys dominated by riffles with occasional pools. Rosgen B-type channels usually have stable bottom material and are more dependent on riparian vegetation and large woody debris for stability (Rosgen 1996).

Where the slope of the watershed changes to less than 7%, the channel types are typically Rosgen C-type channels (stream gradients of less than 2%), also called sediment response or sediment depositional reaches. These are low gradient channels located in gently sloping valleys with floodplains and terraces. These chisel-shaped channels are meandering and slightly entrenched with moderate width to depth ratios. One side of the channel is often shallow, while the opposite side is deep. Under natural conditions, the channels meander at a rate that allows for stream bank stability over 80%. By definition a stable stream bank is associated with a stream that can assimilate its sediment load (Rosgen 2002).

Under deteriorating conditions, width to depth ratios increase, eroded banks are evident, and streams can become severely entrenched. The surface water quality of the tributaries varies throughout the subbasin and is dependent on land uses, local geology, and discharge. Most surface water is of high quality near the source and in the upper reaches. Water quality in the lower reaches tends to decline. Water quality degradation occurs as sediments and other pollutants are deposited into the stream due to natural and anthropogenic processes. Primary anthropogenic sediment sources within the watershed are bank erosion, roads, and agriculture practices. Extreme flow events caused by rain on snow events or heavy precipitation can also cause significant sediment loading to these creeks. Natural erosion from sources such as gullies also contributes sediment to the stream. Surface waters are also affected by irrigation impoundment and diversion structures at lower elevation reaches, which preclude, in some cases, flow from reaching the mainstem Snake River.

Castle Creek

Castle Creek is a perennial stream that drains approximately 129,542 acres and generally flows in a northeasterly direction. The fourth order creek begins at close to 6,700 feet near Toy Mountain pass. Catherine, Browns, Bates, Hart and Pickett Creeks all flow into Castle Creek. After the creek exits the Owyhee front it flows through rangeland and pastures before emptying into the Snake River around 2,400 feet.

The 13-mile listed portion is a Rosgen C channel, a sediment depositing reach characterized by a U-shaped, sandy channel bottom. In swifter parts of the stream, the substrate is made up of partially embedded cobbles. This creek exhibits entrenchment and unstable banks in portions of the lower watershed. A portion of the downcutting is due to episodic rain on snow events and some of the downcutting is attributable to anthropogenic influences such as stream straightening. Where the riparian area has not been disturbed or the channel is not deeply downcut, the riparian area is thick with cottonwoods, willows, wild roses, and grasses.

There are geothermal sources of water in the Castle Creek subwatershed. Some of the warm water enters the creek due to the presence of flowing wells. Land management practices, including using the warm water for irrigation purposes, account for much of the warm water returning to the creek. The Castle Creek watershed has been settled for over 100 years and irrigation development can be traced back to the 1880s, although the greatest amount of irrigation development occurred in the 1950s and 1960s. Mining also occurred historically in the watershed.

Land Ownership and Land Use

The upper part of the Castle Creek watershed is primarily rangeland, while the lower reaches near the Snake River are a mix of irrigated agriculture and rangeland. Additionally, bentonite mining occurs in the watershed. Parts of the watershed are considered to have high mineral potential and sedimentary rock alongside the creek is being mined for industrial minerals (BLM 1999). Figure 1.9 shows the land use patterns within the watershed. While private lands exist in the upper part of the watershed, land is primarily federally owned. Most of the private holdings in the area are closest to the Snake River and around the township of Oreana (DEQ 2002a).

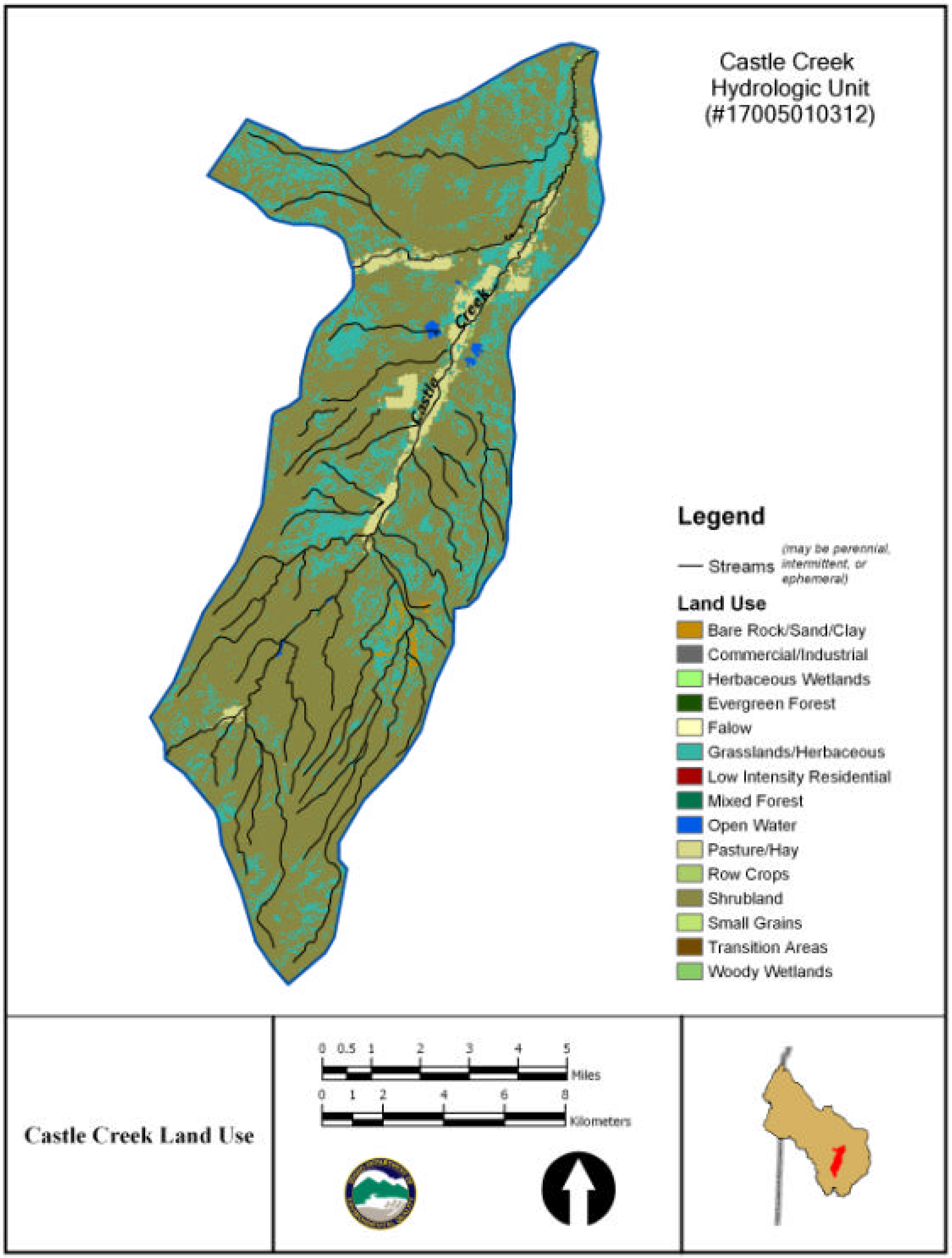

Figure 1.9 Castle Creek Land Use

Jump Creek

Jump Creek is a 25.6-mile long stream that drains a 170 square mile watershed. The elevation change in the watershed is 2,040 feet, with the elevation of the headwaters at 4,240 feet and mouth at 2,200 feet. The headwaters of Jump Creek are located just above the Sands Basin in the Owyhee Mountain Range. After flowing in a northeasterly direction through the Sands Basin, Jump Creek passes through a narrow canyon of sheer rhyolite cliffs. The canyon reaches depths of 600 feet and is often less than a quarter mile across. The rhyolitic tuffs and natural arches that bind Jump Creek as it flows through the canyon are primarily of Miocene volcanic origin. After exiting the canyon, Jump Creek opens up into the low gradient Snake River Plain where it flows in a northerly direction to the Snake River.

The Sands Basin portion of Jump Creek does not have year round flow although perennial pools occur in some years. Flow occurs as a direct result of spring snowmelt or flash flooding from cloudbursts. The flashiness of the stream discourages the growth of a shrub community. Instead, the riparian community consists mostly of tall forbs and mesic site grasses. About 2 miles down the canyon, a series of springs originate along a one-quarter mile stretch of the creek, marking the beginning of the perennial section. Below the springs, the quantity of water gradually increases as the stream mixes with other springs and small intermittent tributaries. Near the end of the canyon the 60-foot Jump Creek Falls occur (Figure 1.10). These falls effectively isolate the upper segment of stream from the lower segment. As the stream enters the Snake River Plain it begins to mix with a series of agricultural drains and small tributaries until it enters the Snake River.

Land Ownership and Land Use

The primary land use within the publicly held portion is rangeland grazing. Within the privately held portion the land uses are primarily agricultural related activities such as rangeland grazing and sprinkler and gravity irrigated cropland. The land uses in the segment being addressed for sediment (although it is not §303(d) listed for sediment) in this TMDL are primarily pasture grazing and irrigated cropland. Figure 1.10 shows the land use patterns within the Jump Creek watershed (DEQ 2002a).

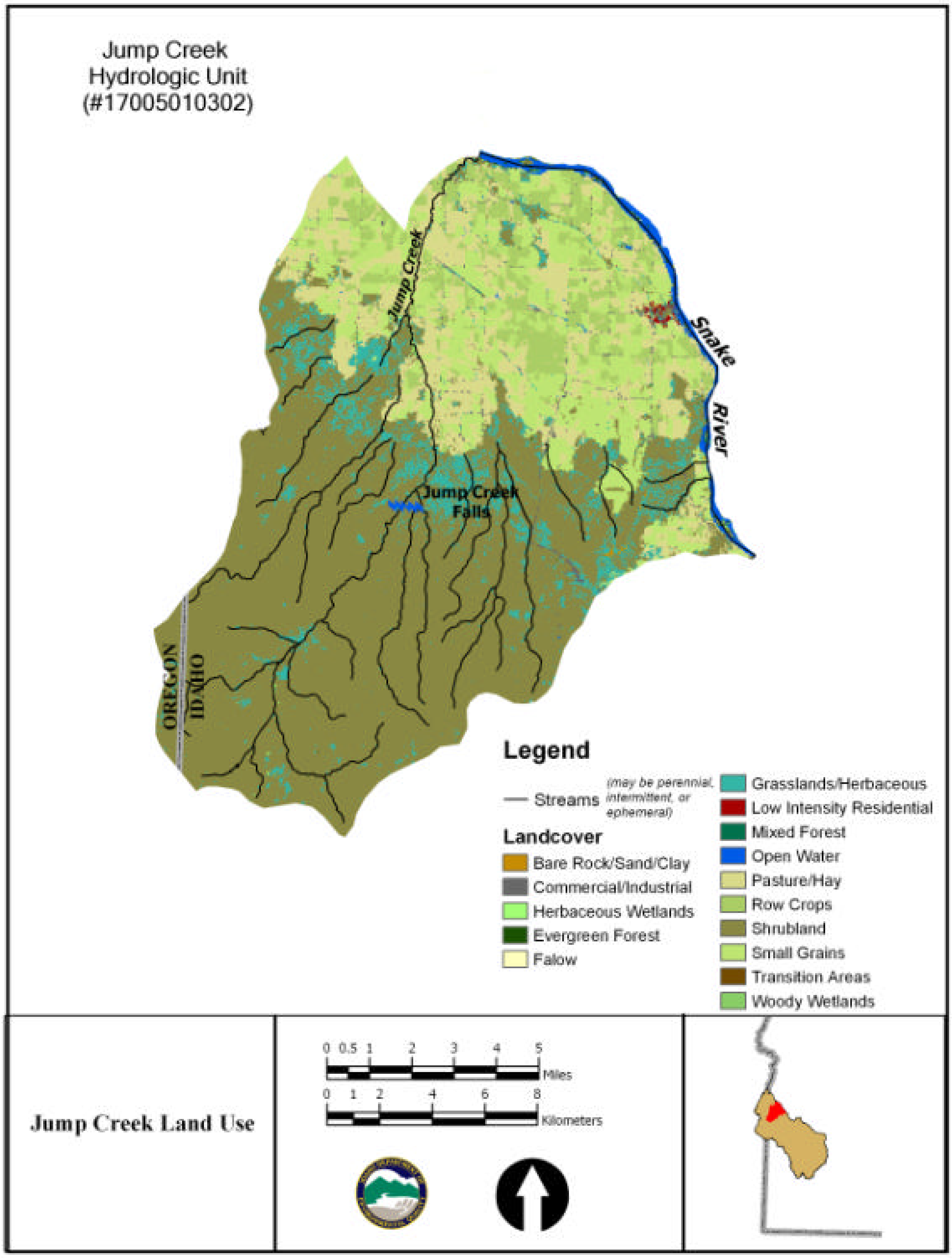

Figure 1.10 Jump Creek Land Use

Reynolds Creek

Reynolds Creek is a 24.5-mile long perennial stream that drains a 138 square mile watershed. The stream originates near Twin Peaks in the Owyhee Mountains and flows in a northerly direction to its confluence with Salmon Creek, where it begins to flow in a northeasterly direction to its confluence with the Snake River. The elevation change in the watershed is 4,520 feet, with the elevations of the headwaters at 6,760 feet and mouth at 2,240 feet. Reynolds Creek flows through four distinct topographic regions where the stream gradient changes distinctly (Figure 1.11 shows the slope of the watershed). From the headwaters to near its confluence with Sheep Creek, the stream flows through steep terrain and is often bounded by canyon walls. From Sheep Creek to near its confluence with Salmon Creek, the stream flows through a high mountain valley. The United States Department of Agriculture (USDA) Reynolds Creek Experimental Station (RCES) and the community of Reynolds are located in this valley. From the Salmon Creek confluence to where it enters the Snake River Plain, steep canyon walls bind the stream. From the canyon mouth to its confluence with the Snake River, the stream flows through a low gradient valley. The last region of the stream is where the §303(d) listed segment is located. Reynolds Creek is §303(d) listed for sediment from the Bernard Ditch to the Snake River. The Bernard Ditch is located approximately 1 stream mile below the mouth of the canyon and originates on private property.

Land Ownership and Land Use

The primary land use within the public land portion of the Reynolds Creek watershed is rangeland grazing, but there is a small amount of forested area near the headwaters. Within the privately held portion the land uses are primarily agricultural related activities such as rangeland grazing and sprinkler and gravity irrigated cropland. Land uses in the §303(d) segment, which is 100% privately held, are primarily pasture grazing and irrigated cropland. Figure 1.12 shows the land use patterns within Reynolds Creek watershed (DEQ 2002a).

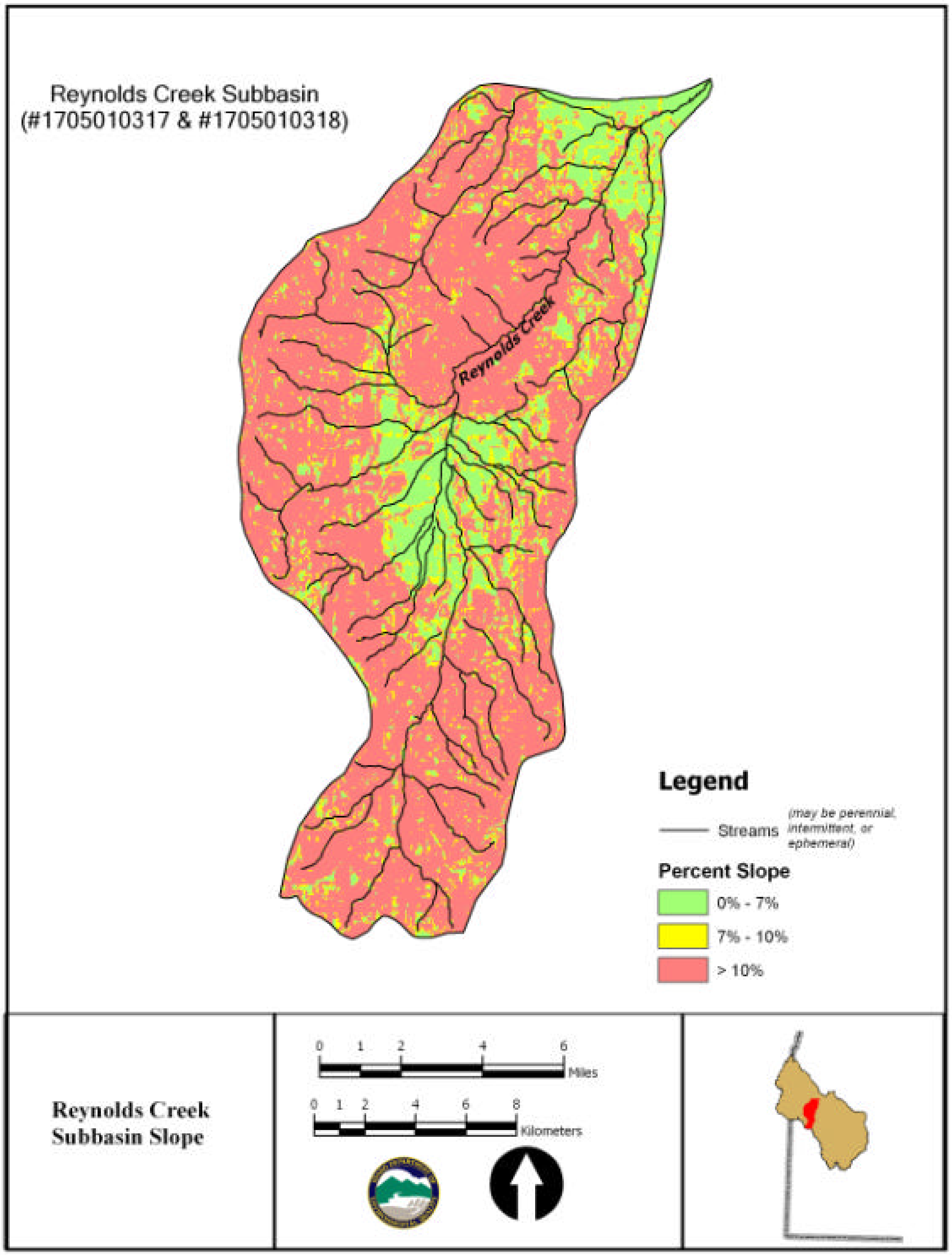

Figure 1.11 Reynolds Creek Subbasin Slope

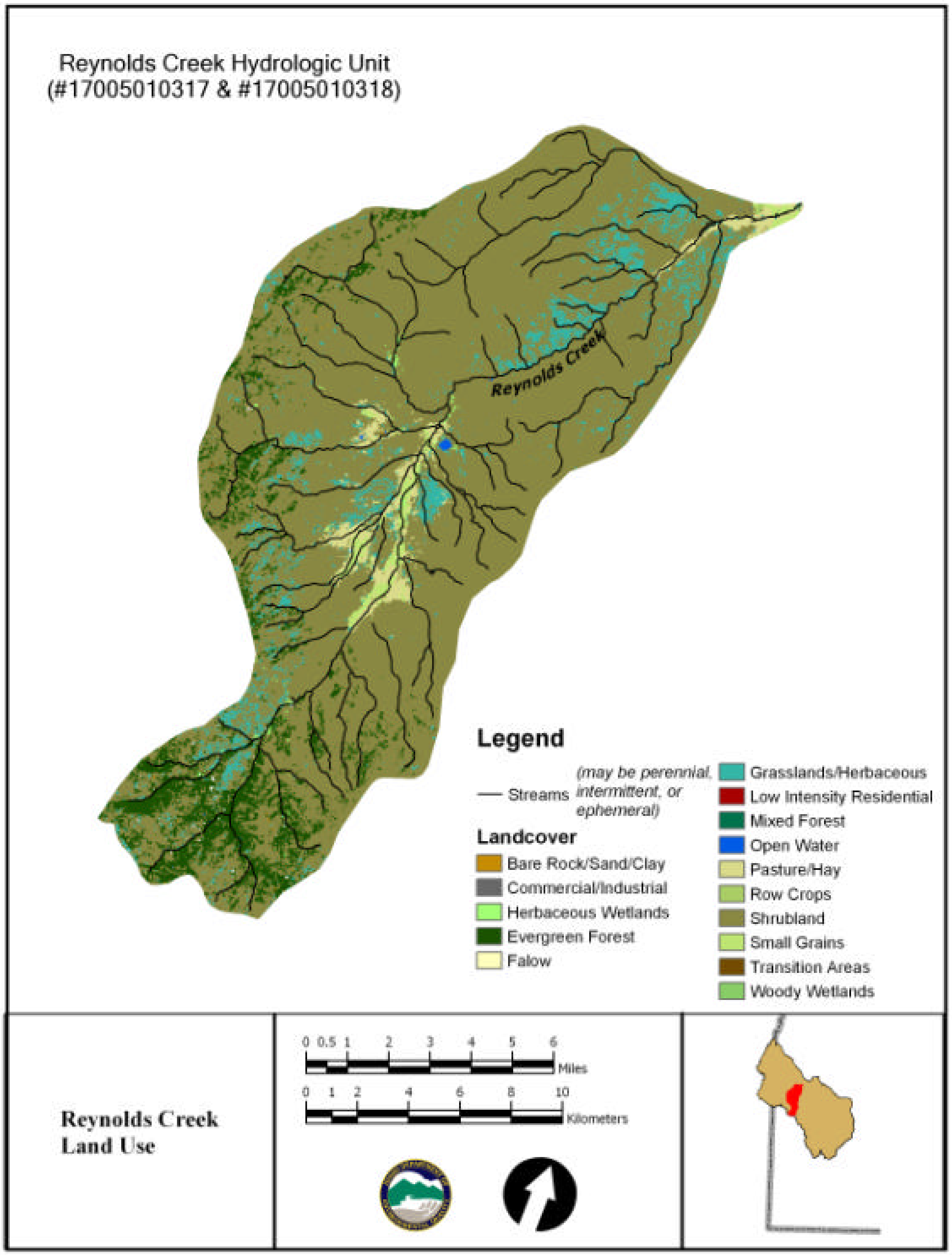

Figure 1.12 Reynolds Creek Land Use

Sinker Creek

As shown in Figure 1.13, Sinker Creek drains approximately 51,671 acres of primarily rangeland. A fourth order, low to moderately sinuous stream, Sinker Creek originates at over 8,000 feet in the Silver City Range of the Owyhee Mountains and flows in a northerly direction into the Snake River at 2,400 feet. Hulet Reservoir is located 12.9 miles upstream from the mouth of Sinker Creek.

Sinker Creek is perennial except in extreme drought years. However, the stream goes dry near the mouth due to flow diversions. Additionally, the nearby Nahas Reservoir is filled with water from Sinker Creek. Sinker Creek cuts through steep V-shaped basalt canyon in places and in others opens up into small low gradient valleys. In the lower sections, the channel is U-shaped.

Land Ownership and Land Use
The primary land use within the publicly held portion is rangeland grazing. Both irrigated agriculture and rangeland grazing occur in the privately owned portion. Figure 1.13 shows land use patterns in the watershed (DEQ 2002a).

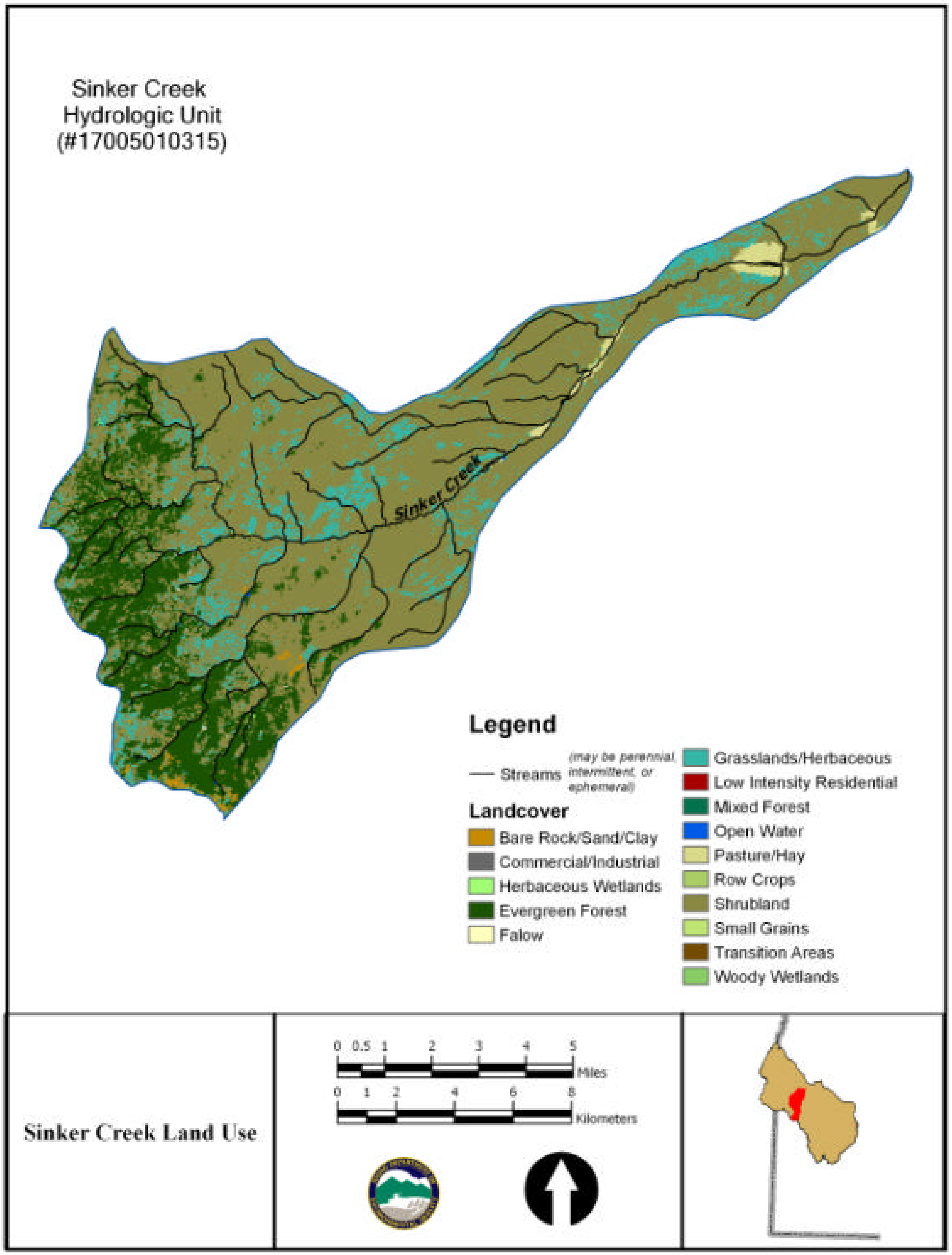

Figure 1.13 Sinker Creek Land Use

Squaw Creek

Squaw Creek drains approximately 83,286 acres of land, flowing mainly in a northeasterly direction. Squaw Creek is characterized by geologic formations of predominantly Miocene age volcanics, and the creek flows through a V-shaped canyon including two constrictions between vertical walls of rhyolite before it exits onto the Snake River Plain. The canyon contains nearly 600 feet of exposed rhyolitic welded tuffs and tuffaceous sediments. The upper watershed consists of steep, sagebrush-grassland slopes and several buttes.

The riparian community, often dense in the canyon sections, is composed of shrubs such as willow, alder, dogwood, chokecherry, currant, and rose.

The section of Squaw Creek exiting the canyon exhibits Rosgen Type B characteristics as it flows through grazing and agricultural land. This section of creek is largely intermittent due to both natural and anthropogenic conditions.

Land Ownership and Use

As shown in Figure 1.14, the upper watershed is primarily rangeland. The Bureau of Land Management (BLM) holds most of the land, although some private land is located in the lower gradient valleys. The lower portion of the watershed is used as rangeland and for irrigated agriculture (DEQ 2002a).

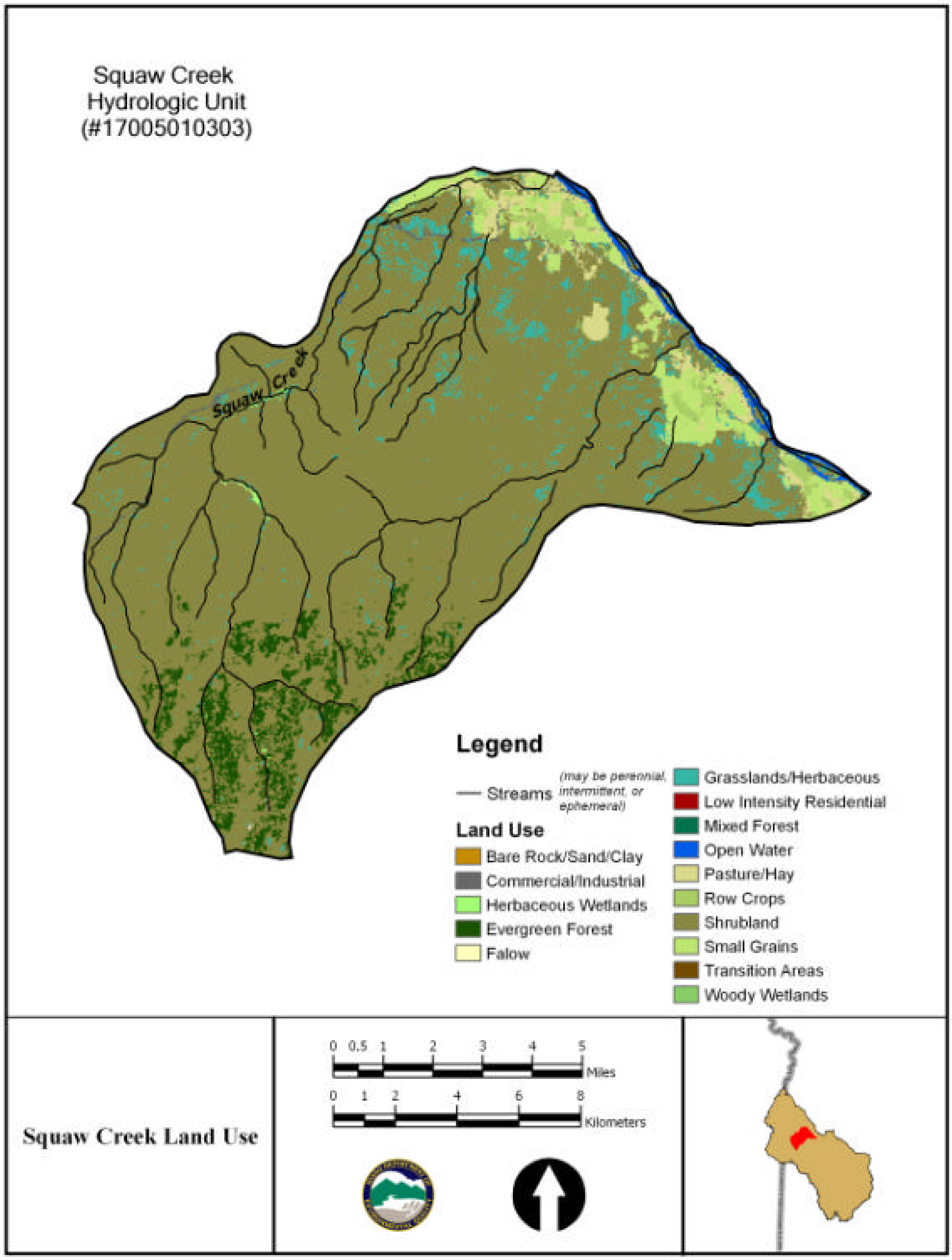

Figure 1.14 Squaw Creek Land Use

Succor Creek

Succor Creek is a 67.3-mile long stream located in the states of Idaho and Oregon. The elevation change in the watershed is 4,400 feet, with the elevation of the headwaters at 6,600 feet and mouth at 2,200 feet. The headwaters of Succor Creek are located approximately 6 miles north of DeLamar, near Johnson Lakes in Owyhee County, Idaho. After flowing in a northeasterly direction to near Rooster Comb Peak, Succor Creek turns to the northwest for approximately 5 miles. The stream then turns to the southwest and enters Succor Creek Reservoir. The reservoir was constructed in 1979 for agricultural storage. After exiting the reservoir, Succor Creek continues to flow in a southwesterly direction for another mile. It then turns to the northwest until it enters Oregon. This entire segment of Succor Creek will be referred to as upper Succor Creek in this subbasin assessment. In Oregon, Succor Creek travels primarily directly north. The stream flows through agricultural land, rangeland and Succor Creek State Park. Succor Creek exits Oregon 5.4 miles above Homedale, Idaho, and travels in a northeasterly direction to its confluence with the Snake River. This segment of Succor Creek (in Idaho) will be referred to as lower Succor Creek in this subbasin assessment. Only the portions of Succor Creek that are in Idaho are addressed in this subbasin assessment.

During most years the entirety of upper Succor Creek is classified as perennial due to the presence of scattered naturally perennial pools that support aquatic life. However, in most years there is no evident flow of water between the pools. Above the reservoir, flow occurs as a direct result of spring snowmelt and the subsequent bank storage. Below the reservoir to the Oregon Line, flow is largely affected by the discharge from Succor Creek Reservoir and the stream rarely is without water. In the lower segment near Homedale (Oregon Line to Snake River), the stream always contains flowing water.

Land Ownership and Land Use

The primary land use within the publicly held portion of the Succor Creek watershed is rangeland grazing, especially in the upper segment. Within the privately held portion the land uses are primarily agricultural related activities such as rangeland grazing and sprinkler and gravity irrigated cropland. Figure 1.15 shows the land use patterns within the Idaho portions of the Succor Creek watershed (DEQ 2002a).

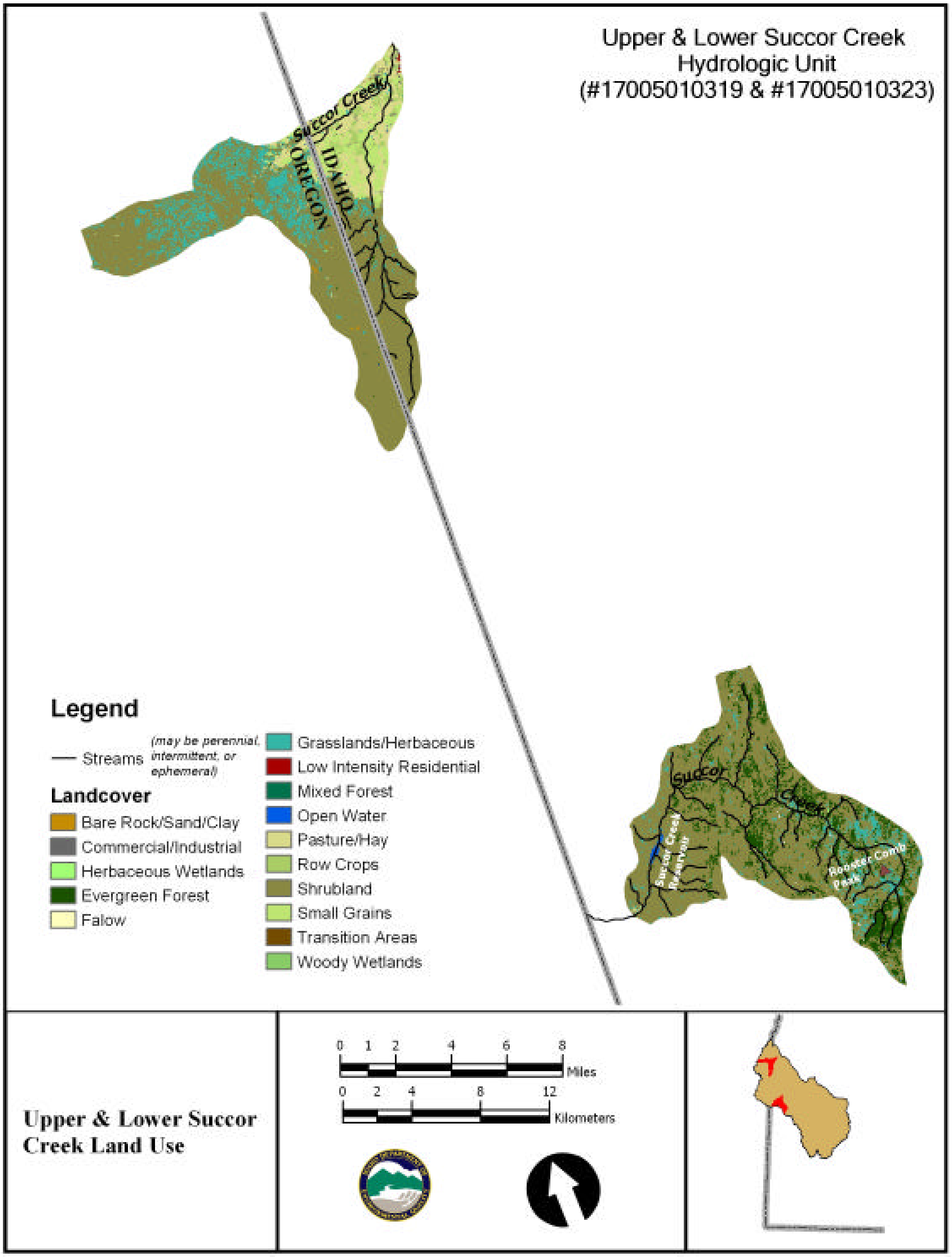

Figure 1.15 Upper and Lower Succor Creek Land Use

1.3 Cultural Characteristics

All watersheds contain aspects that are not directly linked to water quality. These include the history of the area, the past and current economic climate and the distribution of the population within the watershed. This section provides a brief description of these and other aspects of the culture in the Mid Snake River/Succor Creek watershed.

History and Economics

Evidence of human habitation in the Mid Snake River/Succor Creek watershed dates back at least 2,000 years. Remnants of buffalo jumps have been found in the drainage divide between the Mid Snake and Owyhee Rivers (Agenbroad 1976). Hunting and gathering camps have been found along the creeks and river. Petroglyphs can be found throughout the watershed.

The greatest amount of information on Native American settlement in the area is on the Shoshone Tribe. The Shoshone migrated in order to utilize seasonal resources including salmon runs on the Snake River. In the early 1800s the Shoshone started keeping large numbers of horses which they would graze on the bottomlands of the Snake River tributaries (IPC 1998). The Snake River canyon was used as an overwintering location due to abundant fish and game and places to store roots and dried meat. (Murphy 1993). In the fall, Native Americans traveled to the hills and tributary canyons for seed and berry harvesting.

Anglo-European beaver trappers first came to the area in the 1700s but their use of the area was transient and the watershed remained primarily the home of Native Americans. The establishment of the South Alternate Route of the Oregon Trail represented the next significant migration of people, but these were also transient populations. The greatest use of the route occurred in the late 1840s through the 1860s. While the route was shorter than the main trail, the road was harder to travel on and proved to be a more arduous journey (Owyhee County 2002).

In the early 1860s mineral deposits of gold and silver were discovered in the Owyhee Mountains and there was a tremendous migration into the area. At one point, Silver City was the eleventh largest town in Idaho. In general, most of the creeks discussed in this document ever yielded up silver or gold and most mining was in the form of tunneling as opposed to placer mining. Mining continued into the 1900's and then steadily decreased. In response to gold prices, mines still come back into production. Many miners left the area; others found different forms of livelihood.

Cattle and sheep grazing developed in tandem with the mining industry. By 1869 there were several thousand head of cattle in Owyhee County (IPC 1998). In 1882 the number of cattle in Owyhee County numbered 24,559 and by 1889, the peak in cattle occurred with over 100,000 head in the county (Owyhee County, 1898). Thereafter, as the cattle numbers decreased, the sheep industry showed a corresponding increase (by 1898 there over 150,000 head of sheep in the county). In 1934, when overgrazing greatly threatened Western rangelands, Congress approved the Taylor Grazing Act, which for the first time regulated grazing on the public lands through the use of permits. The Taylor Grazing Act provided a way to regulate the occupancy and use of the public land, preserve the land from destruction or unnecessary injury, and provides for orderly use, improvement, and development.

Grazing has had long-term effects on stream hydrology and vegetation throughout the high desert areas of the intermountain west (Platts 1986, Yensen 1982). The introduction of cattle resulted in a decrease in the native perennial grasses and an increase in soil compaction because of trampling by concentrated numbers of livestock (IPC 1998, Yensen 1982, Rauzi et al. 1966, BLM 1999). The change in plant composition resulted in a change in the frequency of fires in the area. In some areas, the shift from seasonal to season long foraging resulted in fireproofing of the sagebrush steppe vegetation. While in other low elevation areas, the rapid spread of the non-native cheatgrass resulted in a floristic change in understory vegetation, which led to an increase in fire frequency due to the increased flammability of the vegetation. The cheatgrass and other mediterranean annuals outcompeted the native herbaceous vegetation (Burkhardt 1995). Current land management practices seek to address this increased fire frequency.

Irrigated agriculture in the Snake River basin dates back to the 1860s and long-term settlement of the area increased as canals and diversions were completed. These settlement patterns resulted in native vegetation (i.e., sagebrush steppe plants) being cleared for fields. The Guffey Railroad Bridge was completed in 1897, and the last train went across in 1948. In the 1920s, more sheep were shipped out of Murphy than anywhere else in North America. After the Walters Ferry Bridge was built in the late 1920s, connecting Owyhee County to roads to the north, use of the railroad steadily decreased.

Located between Kuna and Murphy, Idaho, at river mile 457.7, Swan Falls Dam was the first dam on the Snake River. It was built in 1901 by the Trade Dollar Mining Company to supply electricity to the Trade Dollar mine and excess power was distributed to the mining town of Silver City as well as other mines. The intent was to put in an electric rail since the steep grade to Silver City was hard on boiler engines, but the railroad was never constructed.

The 1900s generally continued the shift to agriculture and grazing that had started in the late 1800s. Today, the Mid Snake River/Succor Creek watershed is sparsely populated and primarily consists of farming and ranching operations.

Livestock production, dairies, farming, and related agricultural industries are the primary economic activities in the watershed. Crops that are farmed include alfalfa hay, grass hay, sugar beets, potatoes, onions, corn, pasture and mixed grain. Farmers depend upon irrigation to grow their crops (Owyhee County 2002).

Land Ownership, Cultural Features, and Population

Twenty five percent of the land in the Mid Snake River/Succor Creek watershed is privately owned. Seventy percent of the land is federally owned. As shown in Figure 1.16, almost all of the public land is managed by the BLM. A small percentage (5%) is state land. Both

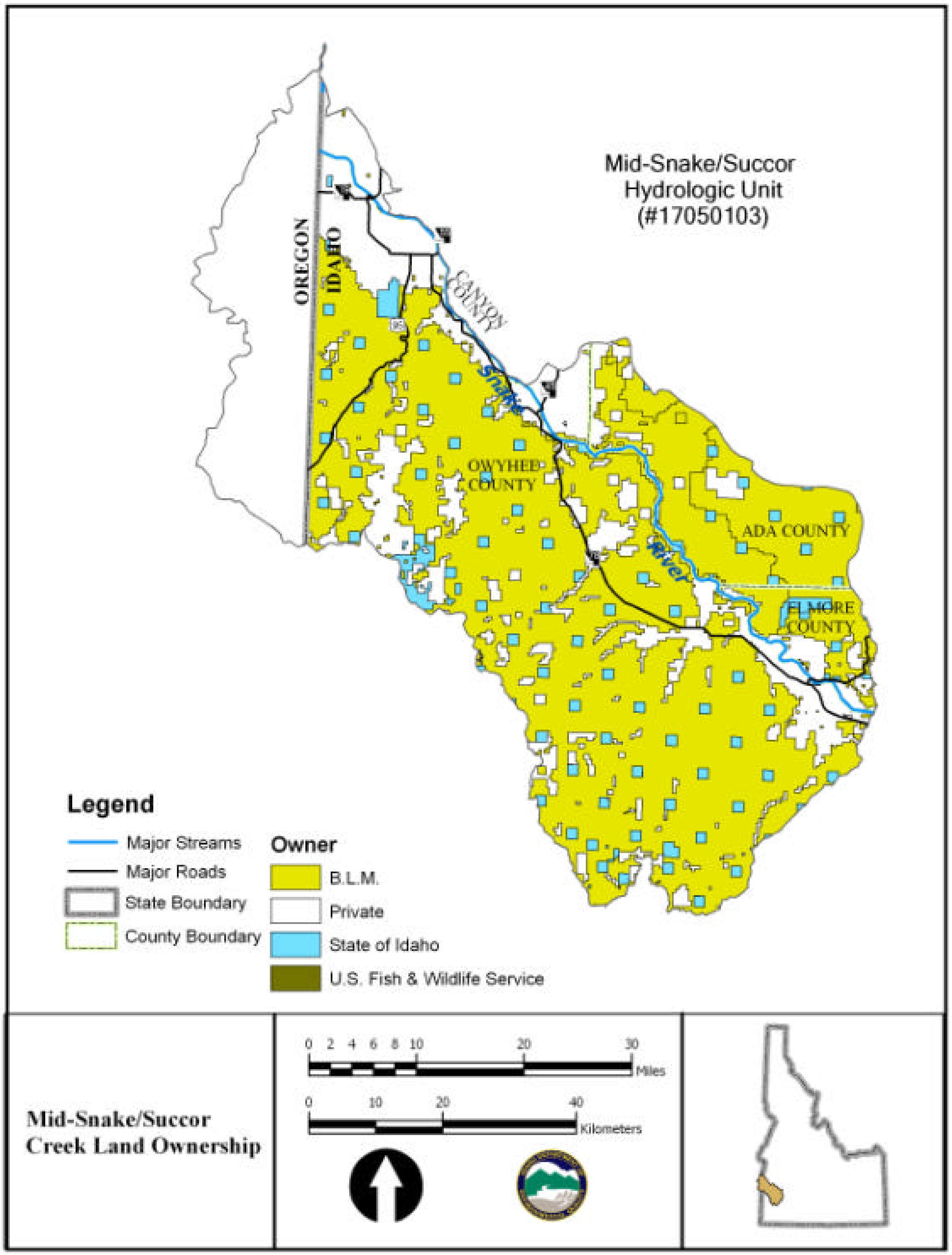

Figure 1.16 Mid Snake Succor Land Ownership

USFWS and the state of Idaho have ownership of the islands in the Snake River below Swan Falls Dam (DEQ 2002a). The sparsely populated Mid Snake River/Succor Creek watershed encompasses parts of Owyhee, Elmore, Ada, and Canyon counties. The agricultural activities in the watershed provide the economic base for the towns and communities in the watershed. Table 3 lists the major towns in the watershed and changes in population over the last 10 years (US Census 2002). While the population has dramatically increased over the past 10 years in some areas, the actual number of people living in the towns in these counties remains small.

Melba and Marsing have to a certain extent become bedroom communities for Nampa, Caldwell, and Boise. Half the population of Melba is estimated to commute to Nampa and Boise for work.

Table 3. Mid Snake River/Succor Creek Watershed Demographics

Town	County	Population (2000)	Population Increase from 1990-2000
Marsing	Owyhee	890	12%
Melba	Canyon	439	74%
Homedale	Owyhee	2528	29%
Grand View	Owyhee	470	42%
Murphy	Owyhee	77	N/A*

Water Resource Activities

Swan Falls Dam, the first dam constructed on the Snake River, is located between Kuna and Murphy, at river mile 457.7. The dam was built in 1901 and Idaho Power Company acquired the dam and power plant in 1916 when the company was formed. The original power plant had 10 generators with a total generating capacity of 10,400 kilowatts. In 1994, new generating units, called "pit turbines," were installed which increased Swan Fall's nameplate generating capacity to 25,000 kilowatts.

Two National Pollutant Discharge Elimination System (NPDES) permitted treatment plants exist within the watershed. The wastewater treatment facilities in Marsing and Homedale were first issued NPDES permits in the mid-1980s.

The Owyhee Natural Resources committee formed in 1992 to address a variety of natural resource issues facing watersheds in the Owyhee County area and the effects that management of the state and federal lands located within the county have on the custom, culture and economy of the county. Another group, The Owyhee Initiative, is made up of a diverse membership of ranchers, environmentalists, public officials, and growers who are working towards a management plan for certain federal lands located within Owyhee

County. Water quality issues are pertinent to streams that are on those lands. Local governments with a stake in water quality issues include Ada, Canyon, Owyhee, and Elmore Counties; the municipal governments of Homedale and Marsing; the Ada Soil and Water Conservation District; the Canyon Soil Conservation District; the Owyhee Soil Conservation District; the Bruneau River Soil Conservation District and the Elmore Soil and Water Conservation District.

Finally, the Snake River Basin Adjudication process affects water rights in this area and by association water quantity and quality. The process, which is slated to be done in the basin by 2005, includes the determination both surface and groundwater rights. This determination, done by the Snake River Basin Adjudication court, includes: ownership, source, quantity, priority date, point of diversion or beginning and ending points for instream flows, purpose of use, period of use, place of use, description of reservations, and applicable general provisions.